BioWest 2005

Track IV: AgBio

Session I: Biorefineries in the West: Fueling the Rural Economy in the 21st Century

Colorado Governor's Office of Energy Management and Conservation (OEMC)

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Biomass: The Future of Energy and the Environment

What is biomass:

- Material remaining from logging, forest thinning, tree damage, recycled or salvaged lumber, crops and crop residue, manure, landfill materials, processed food residue and all other things that are carbonaceous.

Who will be the economic beneficiaries of biomass uses for energy and energy-related products:

- Everyone, in terms of energy and financial security and we will, if done right, reap a healthier environment
- Agriculture, all types, in particular; and
- Existing and new energy companies

Biomass, An Organic Waste And Potential Pollutant, Or A Valued, Energy-Rich Resource

- Manure from billions of livestock and billions of people
- Forest thinnings and logging wastes
- Agriculture waste, including 3-7% “deads”
- Land filled bio-based materials (paper, deads, wood, plastics & other petro-based materials)
- Slaughter-house waste
- Fish (fin and shell) processing waste
- Paper mill wastes
- Some wastes from chemical plants

What Is The Value Of Attracting Biomass Refineries To Colorado

A win-win situation for everyone and agriculture will no longer be an industry that is:

- losing thousands of farms and farm jobs a year and not getting their fair share of many-times-marked-up agricultural products;
- always lagging behind the rest of the country during economic downturns;
- operating on very narrow margins and often barely making ends meet; and
- sometimes accused of not caring about the environment.

What Is The Value Of Attracting Biomass Refineries To Colorado (Cont'd)

With biomass assuming a large energy presence, agricultural interests can:

- produce thousands of jobs through their own energy companies and eliminate middlemen when they directly provide feedstocks to energy companies;
- hold, operate or supply energy companies which seldom see downturns;
- receive good returns from owning, or through association with, solid energy concerns; and
- mitigate or eliminate nearly all the current potential pollution problems associated with agricultural or agriculture-based products and extending and moderating the supply of petroleum-based energy products

Ethanol Plants

Best example of biomass-to-energy success story is ethanol

- Currently in US there is roughly five billion gallons of capacity with another two and one-half billion more gallons on the drawing board or under construction. (The US currently uses about 140 billion gallons of gasoline a year.)
- Ethanol is produced mostly from corn, but it can be made from any crop that contains sugar or directly from sugar itself. It can also be made from celulosic materials like plant residue or, with some processes, from any carbonaceous material.
- Byproducts of ethanol include protein-rich feed supplements for animals, which could be used by people, and pharmaceuticals (mostly cardiac now but shows promise for many ailments).
- Plants are spreading out across the country to better serve population centers. Five new plants are planned to be built in Colorado by first half of 2007

Current Or Planned Colorado Ethanol Plants

- Merrick/Coors, Golden
  - Nine years old, currently yields 1.5 mmg/y from beer waste – will soon double to 3 mmg/y
- Sterling Ethanol, LLC
  - 42 mmg/y from corn
- Front Range Energy, LLC, Windsor
  - 40 mmg/y from corn
- Under Development
  - Great Western Ethanol, Evans
  - Panda Energy, Yuma
  - Sun Energy, Walsh
  - (Project in Lamar?)
  - (Project in Brush?)

Plant Location	Status	Gallons /Year	Number of Jobs	Annual Payroll	Taxes Produced	Feed Stock Acreage	Feed Stock Area
Sterling, CO	in the process of startup now - doing boilouts - product should be out by middle of Nov. Will burn cattle manure in a fluidized bed to power the plant.	30 million annually-start producing 45 million in three months	32	$1.4 million	(?)	15 million bushels per year, 84 million bushels raised in the six counties surrounding Sterling	local corn, then corn from western Nebraska
Baca County - Walsh, CO	should start up by middle of Nov.	3-4 million gallons at start, 8-10 million gallons in one year	15 initially, 20-25 in one year	$312K	(?)	during full production probably 140,000 acres	milo

Yuma, CO	applied for Colo permit - will use manure from feed lots to power plant, prob. mixed with ag waste products - using bubbling bed fluidized boiler	100 million gallons	50-60	$175K	(?)	50 million bushels of corn annually. All the corn in Yuma County, which produces 43 million bushels, won't be enough	will use local corn, then corn from Nebraska and Iowa
Evans, CO	have the permits - should be in production by 12/06 or 01/07.	start out with 70 million gallons, 140 million gallons within one or two years	start with 50, buildup to 55	$2.5 million	based on industry models, about $2.1 million annually	if there is a 200 bushel yield per acre, we'll use 456 acres of corn a day	area corn, then a "corn shuttle" using railroad cars from Nebraska and Iowa

Windsor, CO	under construction now - should be started up by 04/06	40 mmg/y, up to 42 million within six months	35 full time employees when up operational - 100 construction people on site now	$1.5 million	have no idea, it's a $60 million project	85,000 acres at 175 bushel per acre yield	local, then Nebraska and Iowa

Some general industry-established numbers, computed in 2003 and based on five billion gallons of US capacity:

- ~6,000 permanent jobs and 100,000 one-time construction jobs
- ~$163,000,000 in income taxes/year
- ~Gross revenue of $5,000,000,000/year

Current Or Planned Colorado Ethanol Plants

Biodiesel Plants

Coming on strong is biodiesel, which is benefiting from the current energy situation, the overall acceptance of ethanol and ethanol's roughly 35 years of learning how to navigate the petroleum byways and Congress to develop a highly successful product.

- Last year, 25 million gallons were sold and by the end of 2006 there will be a capacity of around 300 million. One billion gallons should be available a few years later.
- Biodiesel is produced from oil seed crops.
- Some byproducts of Biodiesel can include vegetable oils, dust suppressants and lubricants
- Six plants or distributors are currently located in Colorado

Colorado Biodiesel Plants and Distribution Points

- Bio Energy Colorado, Denver
- Rocky Mountain Biodiesel Industries, Berthoud
- Hill Petroleum, Arvada
- Agland/Farmland, Greeley
- Western Petroleum, Glenwood Springs
- Under development or planned
  - Blue Sun Biodiesel, Alamosa
  - Las Animas - Planned

Refineries Treating Carbonaceous Material

At least two refinery types, seriously being considered for Colorado, use very effective, newly applied technologies

- **Thermal Depolymerization**

  Partnership between ConAgra and Changing World Technologies to use slaughter house wastes to create high grade # 2 and #4 oil, liquid and solid fertilizers and gas to run the plant. Process destroys toxins, pathogens and prions (protein "gone bad" forming TSEs). A 200 ton/day waste stream has been treated and produced 500 barrels of oil/day, but evidently the process is undergoing modifications to eliminate some remaining odors.

- **Thermal Hydrolysis**

  Biosphere Technologies' Biorefinex is in pilot scale test in Canada. It has been shown to breakdown slaughter house waste into a light oil (akin to a vegetable oil), gas to run the plant and liquid and solid fertilizers. It too destroys prions, toxins and pathogens.

Thermal Depolymerization (ConAgra and Changing World Technologies)

As shown: an approx. 7 tons/day pilot plant using turkey waste.

A scaled up plant in Carthage, MO is capable of 200 tons/day

Last heard, an approx. 1,000 tons/day plant was being considered for Weld County, CO

Rendering of Biorefinex Refinery

Poop To Power

Anaerobic digestion (AD) of manure, whether municipal or farm, can produce great amounts of power from billions of people and billions of animals.

- Only one active AD in Colorado now, but a few very large ones are under discussion.
- Remaining sludge is essentially pathogen and toxin free and odors have been decreased dramatically as most smelly materials are broken down. Sludge can be land applied or can be composted to supply significant water retention and add much-needed nutrients to the soil.

Other Planned Colorado Biomass Operations

- **Leadville Institute of Science and Technology (LIST)** is considering a pyrolysis gasification process to treat forest waste to make gas, activated carbon, ethanol and hydrogen. They will consider in-forest or site-specific plants.
- **Power Energy Fuels** uses a catalyst to make, from carbon-based items, a fuel trademarked as Ecalene which is termed a higher alcohol. Has been pilot tested under contract with DOE and others and is ready for scale up.
- **Advanced Concept Technologies** uses any carbonaceous material to make hydrogen, and super-clean natural gas for power. The one megawatt pilot scale plant will soon be tested at the USAFA, using on-site forest thinnings.
- **Agriquatics** will use duck weed to test its ability to filter out salts creating salt-laden soils and drinking water and interstate water compact problems. This application will test whether it can replace or supplement the existing municipal wastewater treatment plant while providing electrical power from methane created by AD of pig manure and that from the town's populace; producing animal feed by harvesting the duck weed; and improving tourism by providing hiking, fishing and general recreation within a park-like setting.

Recapping Benefits to Colorado

- Increased price for Colorado grain and oilseed crops
- Decreased (possibly) prices for gasoline and diesel fuel
- Increased revenue for rural areas and jobs for entire state
- Increased State and local tax revenue
- Increased Colorado fuel supply
- Increased energy security
- New (and likely cheaper) production of hydrogen, activated carbon and syngas
- Increased protection from wildfires
- Reductions in pollution concerns and less expenditures to control pollution
- Newfound income from resources previously thought to be waste that required ever-increasing expenses

Conclusions

- Residues that are carbonaceous in nature should never again be called waste – they should be considered among our most valued assets; a valuable, energy-rich resource.
- Current and potential pollution problems can be ameliorated, mitigated, or eliminated and the solution is in the way biomass is utilized Every project, if designed correctly, can have zero off-site emissions of harmful contaminants. There need be no lagoons, essentially no toxins or pathogens and nearly all odor complaints can be handled.

- **BUT, ONE BIG SNAG**!

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